UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/091,106	03/05/2002	John Commander	CEDE 2036	5919

321 7590 05/27/2005

SENNIGER POWERS LEAVITT AND ROEDEL
ONE METROPOLITAN SQUARE
16TH FLOOR
ST LOUIS, MO 63102

EXAMINER	
WONG, EDNA	

ART UNIT	PAPER NUMBER
1753	

DATE MAILED: 05/27/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/091,106	COMMANDER ET AL.	
	Examiner	Art Unit	
	Edna Wong	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 April 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7,14,17,31,43 and 54-64* is/are pending in the application.

4a) Of the above claim(s) *60,61,63 and 64* is/are withdrawn from consideration.

5)☒ Claim(s) *1-7,17,31 and 43* is/are allowed.

6)☒ Claim(s) *14 and 54-59* is/are rejected.

7)☒ Claim(s) *62* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

This is in response to the Amendment dated April 29, 2005. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Response to Arguments

Claim Rejections - 35 USC § 112

Claims **6 and 59** have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The rejection of claims 6 and 59 under 35 U.S.C. 112, second paragraph, has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 103

Claims **14 and 54-59** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Kardos et al.** (US Patent No. 3,956,078) in combination with **Barstad et al.** (US Patent No. 6,444,110 B2).

The rejection of claims 14 and 54-59 under 35 U.S.C. 103(a) as being unpatentable over Kardos et al. in combination with Barstad et al. has been withdrawn in view of Applicants' amendment.

Response to Amendment

Election/Restrictions

This application contains claims **60-61 and 63-64** drawn to an invention nonelected with traverse in the Paper filed July 26, 2004. A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

Claim Rejections - 35 USC § 112

Claims **14, 54-59 and 62** are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 14, lines 4-6, recites "submicron-sized reliefs having height-to-diameter aspect ratios of at least about 4:1 therein". This is not described in Applicants' specification, and thus, is new matter. See also claim 14, lines 15-16.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims **14 and 54-59** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Barstad et al.** (US Patent No. 6,444,110 B2).

Barstad teaches a method for electroplating a copper deposit onto a semiconductor integrated circuit device substrate (= semiconductor integrated circuits) [col. 3, lines 55-56] having electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs having height-to-diameter aspect rations of at least about 4:1 therein (col. 2, lines 50-52; and col. 7, line 66 to col. 8, line 7), the method comprising:

(a) immersing the semiconductor integrated circuit device substrate into an electroplating bath including ionic copper (col. 4, lines 7-19) and an effective amount of a defect reducing agent (= a brightener, suppressor, or leveling agent) [col. 5, lines 3-67; col. 6, lines 23-58; and col. 6, line 63 to col. 7, line 19] which reduces the formation of internal voids within the copper deposit (= the use of a suppressor agent in combination with elevated brightener concentrations can result in effective "bottom-fill" copper plating of a microvia or other aperture without defects such as inclusions or voids) [col. 3, lines 20-30]; and

(b) electroplating the copper deposit from said bath onto the semiconductor integrated circuit device substrate to superfill the submicron sized reliefs having the aspect ratios of at least about 4:1, which deposit is characterized by a reduced concentration of internal voids (col. 7, line 46 to col. 8, line 7).

The defect reducing agent improves distribution of deposited copper over the

substrate surface (= leveling agent) [col. 6, line 63 to col. 7, line 19].

Barstad does not teach wherein the defect reducing agent reduces a rate of recrystallization and grain growth in the copper deposit.

However, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because voids are formed during the crystal grain growth in the copper deposit. Since the use of a suppressor agent in combination with elevated brightener concentrations can result in effective "bottom-fill" copper plating of a microvia or other aperture *without defects such as inclusions or voids* as taught by Barstad (col. 3, lines 20-30). The crystal grain growth in the copper deposited by Barstad would have been small because smaller grain sizes facilitate deposition into deep features that have very high aspect ratios without the formation of gaps or other voids. The suppressor and/or brightener would have promoted smaller grain sizes by interfering with the crystal orientation of copper nucleation sites in the deposited film, and thus, would have inherently reduced a rate of recrystallization and grain growth in the copper deposit.

As to wherein the deposit subsequently undergoes recrystallization and grain growth at a reduced rate, similar processes can reasonably be expected to yield products which inherently have the same properties. *In re Spada* 15 USPQ 2d 1655

(CAFC 1990); *In re DeBlauwe* 222 USPQ 191; *In re Wiegand* 86 USPQ 155 (CCPA 195).

As to wherein the defect reducing agent reduces high current density edge effect during electroplating, Barstad teaches brighteners, suppressors and leveling agents (col. 5, lines 3-67; col. 6, lines 23-58; and col. 6, line 63 to col. 7, line 19). It has been held that a newly discovered use or function of components does not necessarily mean the system is unobvious since this use or function may be inherent in the prior art. *Ex parte Pfeiffer* 135 USPQ 31.

As to wherein the deposit has a deposit thickness of about 1 micron and which varies by no more than about 0.2 microns across the deposit, the deposit thickness being measured from an upper surface of the deposit to the substrate surface at its thickest point, the thickness of the deposit is well within the skill of the artisan dependent upon the intended use of the device, particularly to the environment to which the device will encounter, which would be most suited for the application of the device, absent evidence to the contrary.

Furthermore, the thickness of the deposit is well within the skill of the artisan dependent upon the size of the features.

As to the deposit thickness being measured from an upper surface of the deposit to the substrate surface at its thickest point, if the deposit thickness varies by no more

than about 0.2 microns across the deposit, then measuring the deposit thickness at its thickest point would have revealed this, and that any other point beyond this would have been outside this range.

As to wherein the defect reducing agent facilitates deposition of a thinner overall deposit to achieve a minimum thickness across the substrate than an overall deposit required achieve such minimum thickness by electroplating without said defect reducing agent, Barstad teaches brighteners, suppressors and leveling agents (col. 5, lines 3-67; col. 6, lines 23-58; and col. 6, line 63 to col. 7, line 19). It has been held that a newly discovered use or function of components does not necessarily mean the system is unobvious since this use or function may be inherent in the prior art. *Ex parte Pfeiffer* 135 USPQ 31.

As to removing a portion of the copper deposit by chemical and mechanical action to yield a level substrate, wherein an amount of copper deposit to be removed is less than an amount of copper deposit which must be removed by chemical and mechanical action to yield a level substrate in a comparable substrate electroplated without said defect reducing agent, Barstad appears to disclose a method at least in a similar manner as instantly claimed. Therefore, it would have been within the skill of the art to expect that a portion of the copper deposit removed by chemical and mechanical action to yield a level substrate, wherein an amount of copper deposit to be removed

would have been less than an amount of copper deposit which must be removed by chemical and mechanical action to yield a level substrate in a comparable substrate electroplated without said defect reducing agent.

Chemical mechanical polishing is conventional in the art to remove a portion of a copper deposit.

As to wherein pitting corrosion from said chemical action is less severe than pitting corrosion in the comparable substrate electroplated without said defect reducing agent, Barstad appears to disclose a method at least in a similar manner as instantly claimed. Therefore, it would have been within the skill of the art to expect that the pitting corrosion from said chemical action would have been less severe than pitting corrosion in the comparable substrate electroplated without said defect reducing agent.

Allowable Subject Matter

The following is a statement of reasons for the indication of allowable subject matter:

Claims **1-7** define over the prior art of record because the prior art does not teach or suggest a method for electroplating a copper deposit onto a semiconductor integrated circuit device substrate with electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs therein, the method comprising the steps of immersing and electroplating as presently claimed,

esp., wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine.

Claim **17** defines over the prior art of record because the prior art does not teach or suggest a method for electroplating a copper deposit onto a semiconductor integrated circuit device substrate having electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs therein, the method comprising the steps of immersing and electroplating as presently claimed, esp., wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine.

Claim **31** defines over the prior art of record because the prior art does not teach or suggest the concentrate for preparation of a copper electroplating bath for electroplating a copper deposit onto a semiconductor integrated circuit device substrate having electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs therein, the concentrate comprising copper ions and a defect reducing agent as presently claimed, esp., wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine.

Claim **43** defines over the prior art of record because the prior art does not teach or suggest a concentrate for preparation of a copper electroplating bath for electroplating a copper deposit onto a semiconductor integrated circuit device substrate having electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs therein, the concentrate comprising copper ions and

a defect reducing agent as presently claimed, esp., wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine.

Claim **62** defines over the prior art of record because the prior art does not teach or suggest the method of claim 14 wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine.

The prior art does not contain any language that teaches or suggests the above. *Barstad et al.* do not teach wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine. Therefore, a person skilled in the art would not have been motivated to adopt the above conditions, and a prima facie case of obviousness cannot be established.

Claim 62 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Edna Wong
Primary Examiner
Art Unit 1753

EW
May 25, 2005